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Biological Services Program

FWS/OBS-78/79
September 1978

MANAGEMENT OF WINTERING BALD EAGLES

Fish and Wildlife Service

U.S. Department of the Interior

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To strengthen the Fish and Wildlife Service in its role as a primary source of information on national fish and wildlife resources, particularly in respect to environmental impact assessment.

To gather, analyze, and present information that will aid decision-makers in the identification and resolution of problems associated with major changes in land and water use.

To provide better ecological information and evaluation for Department of Interior development programs, such as those relating to energy development.

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MANAGEMENT OF WINTERING BALD EAGLES

by

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U.S. Fish and Wildlife Service
Contract No. 14-16-0006-77-030

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Performed for
Eastern Energy and Land Use Team
Water Resources Analysis
(Formerly National Stream Alteration Team)
Office of Biological Services
Fish and Wildlife Service
U.S. Department of the Interior

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EXECUTIVE SUMMARY

Because of human encroachment, wintering bald eagles have been concentrated at a few sites where habitat and food supplies are adequate. Proper management of these wintering sites is essential for preserving and enhancing bald eagle populations. Guidlines are provided to give managers of sanctuaries and public lands information that will enable them to manage land specifically for migratory northern bald eagles during the non-breeding season. The basic findings of the study are as follows:

1. Bald eagles congregate at specific wintering sites from late October through March. Open water on major river systems usually attracts bald eagles, but eagles also use arid valleys in winter.

2. Dams have caused changes in the bald eagle's winter distribution, and eagles have shifted distribution to utilize other newly created food sources.

3. Eagles tend to winter farther south during colder winters. Immature eagles apparently winter farther south than adults and may migrate south earlier than adults. Eagle numbers fluctuate considerably at particular wintering areas.

4. Bald eagles roost communally throughout the winter range. Weather conditions strongly influence eagle activity patterns in winter.

5. The feeding habits of wintering bald eagles are diverse, changing with both season and region. Fish are the most important food in many regions. Eagles eat several fish species and depend primarily on those fish that are dead, dying, stranded, or otherwise vulnerable. Where fish are abundant, waterfowl and other birds are secondary or unimportant food items. In heavily hunted waterfowl concentration areas, however, bald eagles are attracted to the abundance of crippled waterfowl and feed almost exclusively on avian carrion. Wintering bald eagles also consume mammals, especially in the Western States.

6. Managers should see that food sources are available throughout the winter during all weather conditions. Enhancement of habitat for fish, upland game, and wintering waterfowl will increase food for wintering bald eagles.

7. Proximity to a food source is probably the most important factor influencing diurnal perch selection by eagles. Eagles prefer tree perches over other types of perches, and most tree perches selected are bordered by open area. Preferred perch trees are large with stout, horizontal branches. Some tree species are more suitable than others for perches, and in some regions eagles prefer dead trees. Roosting habitat requirements are different from those of diurnal perches. Winter roosts are well protected from wind, and proximity to a food source is not a critical requirement. Roost trees are sometimes larger than diurnal perches, and many roosts are bordered by open area.

8. Managers may be able to attract eagles to public lands and sanctuaries by enhancing perching sites. Snags and large trees near shorelines should be preserved. Young and maturing stands can be pruned and thinned to develop growth forms preferred by eagles. Communal roosts should be identified and preserved because they are focal points for eagle activity. Managers should develop potential roosts in all successional stages and should plant new trees and tree stands in some areas.

9. Eagles prefer areas with limited recreational activity but use moderately disturbed sites where food supplies are abundant. Eagles tolerate more disturbance at feeding sites than at loafing or roosting sites. Automobile traffic is one of the least disturbing human activities, but boats can disrupt eagle activity patterns.

10. Restriction of public use to designated zones and types of vehicular use will minimize disturbance to wintering eagles. Wooded summer campgrounds and farming operations appear to be compatible with winter eagle use.

11. Powerlines, if not properly constructed or modified, can be a significant cause of eagle mortality especially in broad, flat valleys where natural perches are not available.

12. Managers should discourage construction of powerlines at eagle wintering sites, especially near communal roosts. New powerlines should be constructed without electrocution hazards, and some existing powerline poles should be modified to eliminate these hazards.

13. Inventories can provide indexes to regional or national population trends and annual or seasonal changes in numbers at wintering sites. Managers can provide compilers with complete and accurate counts by coordinating surveys and using optimal survey procedures.

This report was submitted in fulfillment of Contract Number 14-16-0006-77-030 by the author under the sponsorship of the Office of Biological Services, U.S. Fish and Wildlife Service. Work was completed as of May, 1978.

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INTRODUCTION

Past declines in bald eagle numbers have accentuated the need for intensive species management. Habitat requirements for nesting eagles have been determined, and some northern forests are presently managed for bald eagles. On the winter range, habitat encroachment by humans is extensive, and eagles now concentrate at a few sites where habitat and food are still available. Because preservation of winter habitat may become a critical component of bald eagle management, an understanding of the habitat requirements of wintering bald eagles is essential.

Since 1974 private organizations have purchased and set aside land for refuges for wintering bald eagles in South Dakota, Wisconsin, Washington, Illinois and California. In addition, public agencies are beginning to recognize the potential value of their land for non-game and endangered species. In some areas, land and water developments have created new potential habitat.

This report attempts to give managers of sanctuaries and public lands the information that will allow them to manage land specifically for wintering bald eagles. This handbook is appropriate for lands used by migratory northern bald eagles during the non-breeding winter season. Areas where bald eagles both breed and winter may require different management approaches. The information contained in this report is only the first step towards a comprehensive management plan. It is hoped that managers will utilize this information and their own imaginations to develop new ways to improve bald eagle wintering habitat.

Figure 1. The bald eagle (Haliaeetus leucocephalus) is the only North American representative of the fish or sea eagles (photo by author).

MANAGEMENT GUIDELINES

The purpose of managing wintering bald eagles is to send the maximum number of eagles back to the breeding grounds in good physiological condition (Fig. 2). This requires safe, adequate, and attractive habitat throughout the winter range. Maintenance of suitable habitat involves manipulation of food supply and vegetative habitat, restriction of human disturbance, and legal protection and enforcement (Fig. 2). Both existing eagle wintering areas and potential wintering sites should be targets for eagle habitat management.

FOOD SUPPLY

Food supply is probably the most critical feature of the biology of wintering bald eagles. It is important to manage and maintain food sources thoughout the winter during all weather conditions. The following guidelines should be helpful.

1. Preserve and enhance populations of major fish species in the area. Salmon, goldeye, carp, shad, and bass are important target species. It is essential to ensure adequate reproduction for these species. Siltation from roads, logging, or overgrazing may interfere with reproductive success. The presence of gravel bars mixed with deep pools is critical for reproduction of many riverine species.

2. Stock fish in small impoundments that do not presently support fish populations. Annual stocking of waters that freeze in winter will provide a source of winterkilled fish for eagles in spring and recreational opportunities in the summer.

3. Manipulate water levels, where possible, to promote periodic stranding of fish. Use this option only when the practice does not threaten desirable fish populations. Artificial stranding in eagle wintering areas may be a potential tool for controlling trash fish.

4. Discourage stream channelization efforts; preserve and develop winding, braided river stretches that facilitate stranding of fish. This is particularly important for fish species that spawn only once. It may be necessary to remove shrubby vegetation from stranding areas so that carcasses are visible to eagles.

5. Consider artifical feeding programs using hatchery fish during unusually critical food shortages. Dead fish can be released into river systems from hatchery holding ponds, and stored frozen carcasses can be deposited on open shorelines. This technique has been appropriate primarily on salmon spawning grounds during floods and serious fish population declines.

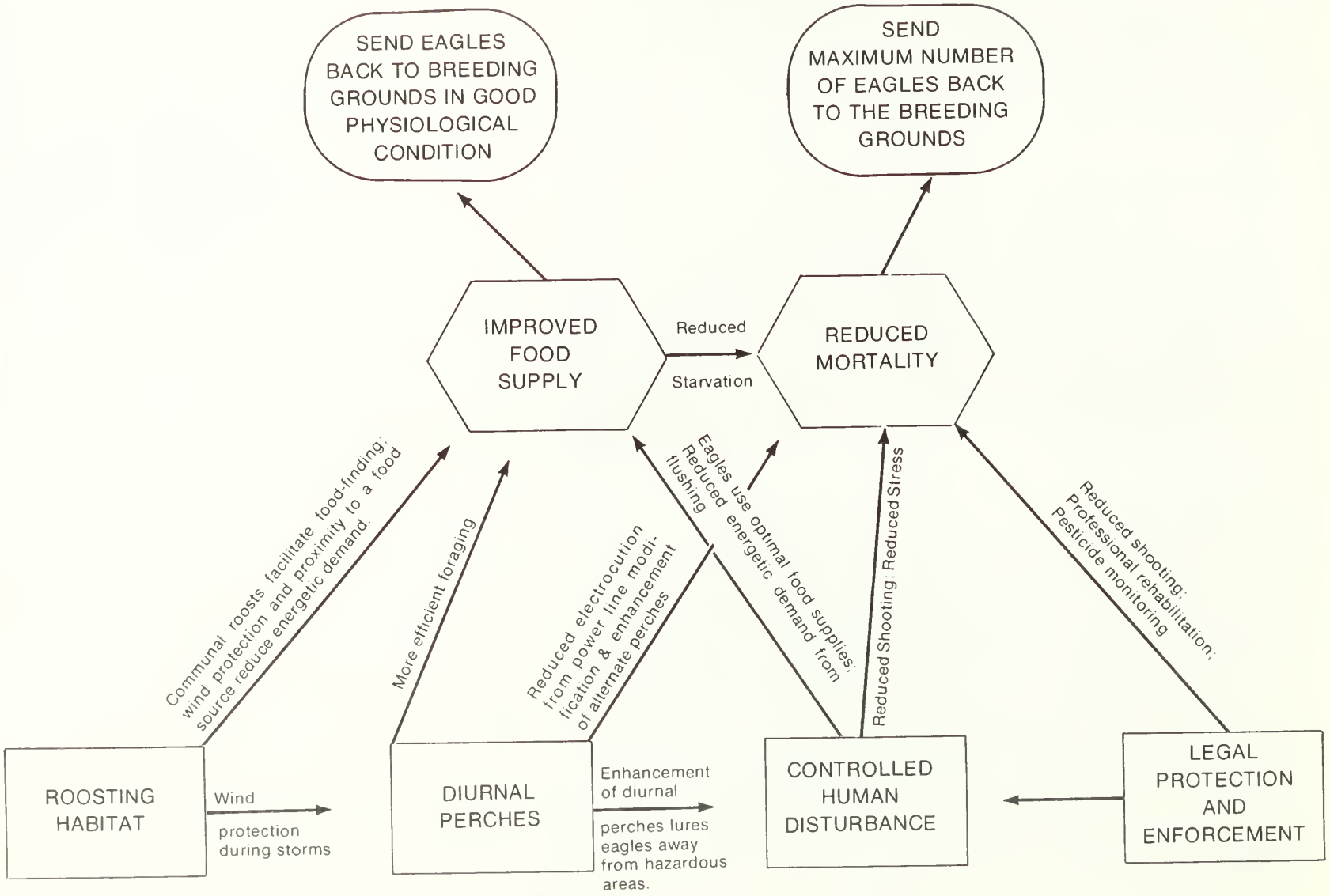

SEND EAGLES BACK TO BREEDING GROUNDS IN GOOD PHYSIOLOGICAL CONDITION
SEND MAXIMUM NUMBER OF EAGLES BACK TO THE BREEDING GROUNDS
IMPROVED FOOD SUPPLY
Reduced Starvation
REDUCED MORTALITY
Communal roosts facilitate food-finding; wind protection and proximity to a food source reduce energetic demand.
More efficient foraging
Reduced electrocution from power line modification & enhancement of alternate perches
Eagles use optimal food supplies; Reduced energetic demand from flushing
Reduced Shooting, Reduced Stress
Reduced shooting; Professional rehabilitation; Pesticide monitoring
ROOSTING HABITAT
Wind protection during storms
DIURNAL PERCHES
Enhancement of diurnal perches lures eagles away from hazardous areas.
CONTROLLED HUMAN DISTURBANCE
LEGAL PROTECTION AND ENFORCEMENT

Figure 2. Strategy for managing wintering bald eagles.

6. Attract waterfowl to existing open water situations by habitat manipulation, including the establisment of food plots (e.g. fields of unharvested corn). The practice of baiting of other artifical means of attracting waterfowl should be idscouraged. A small population of waterfowl will support several wintering eagles. However, since avian cholera and lead poisoning have both been diagnosed as causes of eagle mortality managers should determine causes of waterfowl providing carcasses as a food source. The National Fish and Wildlife Health Laboratory should be contacted for diagnostic assistance and support. If waterfowl mortality is caused by an agent hazardous to eagles, an intensive program of carcass pick-up and disposal should be initiated, or the eagles should be denied use of this area.

7. Support habitat improvement practices for upland game. Pheasants, cottontails, and jackrabbits are important alternate foods for eagles. Brushpiles, shelterbelts, and uncultivated fencerows provide good habitat for upland game. Areas of dense rank cover also provide habitat for upland game and should be preserved.

8. Do not allow open bait trapping or use of poisoned bait within the area used by eagles. Eagles are attracted to these potential food sources and may be killed or injured. Scent traps are not directly hazardous to birds of prey. However, healthy coyote populations can benefit wintering eagles because coyotes frequently open frozen carcasses and make them available to eagles.

9. Leave deer carcasses on the wintering site for future use by eagles. In emergency weather situations, it may be desirable to deposit additional carcasses. Local game wardens may have roadkills available for supplemental feeding.

HABITAT

Diurnal Perches

Availability of diurnal perches probably does not limit bald eagles. Distribution of bald eagles, however, is directly influenced by the location of preferred perches. In areas where food is already available, enhancement of perching sites can attract bald eagles to public lands and sanctuaries (Fig. 3) and guide them away from hazardous situations (powerlines, roads, human disturbance, shooting). The following guidelines should be helpful.

1. Do not remove trees that are within 30 m (33 yd) of a riverbank or lakeshore if they have diameters exceeding 30 cm (12 inches). These are usually preferred perches.

2. Do not remove snags because they may be preferred perches in some areas.

3. Consider thinning young tree stands. Selective thinning stimulates growth of existing trees and creates openness around potential perch trees.

Figure 3. In areas where food is available, suitable perching sites can attract bald eagles to public lands and sanctuaries (U.S. Fish and Wildlife Service photo).

4. Create openings in dense stands. Trees interspersed with open areas are attractive to eagles.

5. Consider girdling a few trees to create snags in coniferous stands. Interspersed snags in coniferous stands provide the openness that eagles prefer. It is probably not necessary to deliberately create snags in deciduous stands because bald eagles readily use live trees when dead trees are not available. It is best to allow trees to attain maximum size before girdling.

6. Establish new trees in areas devoid of tree reproduction (especially along shorelines of newly established reservoirs). New plantings should be within 30 m (33 yd) of a bank. Cottonwood, maple, and sycamore should be the target species for management because of their suitable growth form. Cottonwoods are the best species to propagate in the Midwest because they grow rapidly and eagles prefer them. A detailed description of cottonwood planting techniques is given in Appendix A.

7. Prune or graze saplings and young trees to stimulate forking, horizontal branch development, and the growth form preferred by eagles.

8. Do not depend on artifical perches to be effective replacements for natural wooded habitat. Artificial perches on bald eagle wintering areas thus far have been only partially successful. Experiment with unique perch designs, especially near feeding sites in treeless areas.

9. In areas where beavers are abundant and destructive, protect eagle perch trees by painting the trunks with creosote or enclosing them in 1 m (3 ft) high wire netting.

Communal Roosts

Communal roosts are focal points for wintering bald eagle activity, and the same roost sites are used by eagles for several years. Roost sites provide protection from wind and may facilitate food finding. All existing communal roosts should be preserved. Managers should also develop alternate roosting sites to maintain and enhance the value of sanctuaries and refuges.

1. Identify all communal roosts on the wintering area.

2. Determine the area needed to protect the roosts from human disturbance and habitat alteration. (For example, in South Dakota it was necessary to protect a stand of small trees on the bank that served as a wind barrier for roost trees.)

3. Eliminate existing threats to the roosting stand. (For example, riverbank stabilization was necessary in South Dakota.)

4. Make arrangements to preserve roosting stands through purchase, exchange, or cooperative agreements with either the private landowner or the government agency administering the land. The National Wildlife Federation, the Nature Conservancy, and the Audubon Society are possible funding sources. If purchase is not feasible, it may be desirable to buy an easement to protect habitat on private land. An appropriate easement is presented in Appendix B.

5. Identify and protect potential roost sites on the wintering area. Wind-protected valleys are good prospects for roost sites. Stands of large trees should be targets for development of roosts. The presence of one or two eagles may indicate the potential of alternate sites.

6. Create potential roosts in large dense stands by cutting a 30 m (33 yd) belt around a rectangular 5 ha (12 acre) stand of trees.

7. Establish new roosts in open, treeless areas by planting (Appendix A). Roosting stands should be 2 to 5 ha (5 to 12 acres), preferably rectangular. Establish windbreaks 30 to 50 m (33 to 55 yd) from the potential roosting stand.

8. Plan to develop potential roosts in all successional stages on the wintering area to ensure the presence of suitable sites for many years.

POWERLINES

Several types of powerlines now traverse bald eagle wintering areas. In addition, land managers often must recommend which, if any, new powerlines should be constructed. Managers can and should minimize the potential for powerline accidents that could kill or injure eagles. The following guidelines should be helpful.

1. Do not allow construction of high voltage powerlines within 1.5 km (1 mi) of communal roosts. Eagles use these areas during strong winds and poor light conditions, and the potential for accidents is high.

2. Discourage construction of any new powerlines in bald eagle wintering areas. Grant permission for new transmission lines on public lands and sanctuaries only according to guidelines in "Suggested Practices for Raptor Protection on Powerlines" (Appendix C).

3. New distribution and subtransmission lines should have armless construction (Fig. 4) or modified crossarms with 109 cm (43 inch) vertical separation between the center conductor and two outside conductors (Fig. 5).

4. Identify poles preferred by eagles as perches and change the construction, if necessary. Existing crossarm poles can be modified by adding a pole top extension that provides vertical separation. Install conductor insulation covers if re-construction is impractical (Fig. 6). Use wood or nonconductive braces on poles where braces are

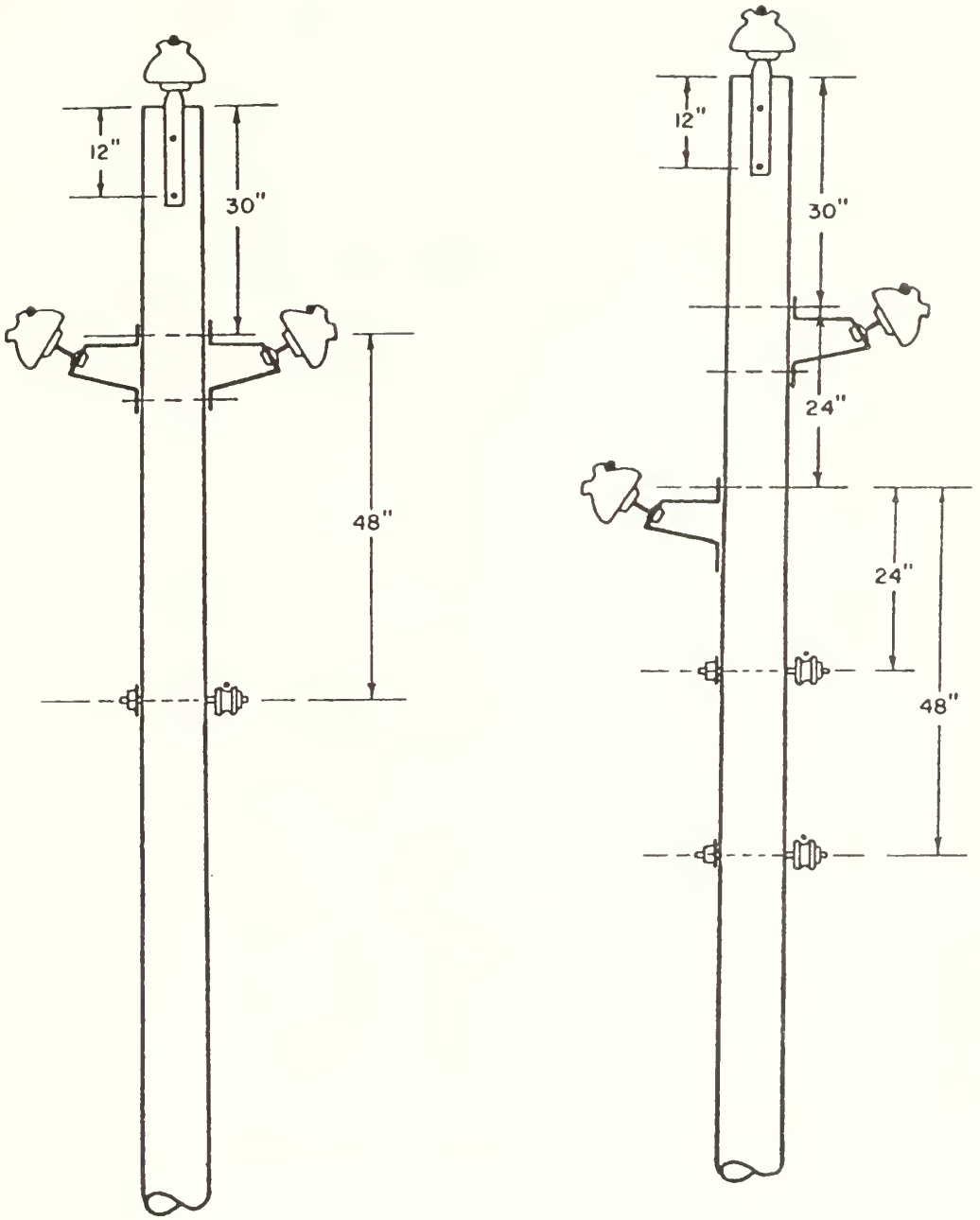


Figure 4. New distribution and subtransmission lines should have either staggered or triangle armless construction. (Courtesy of Idaho Power Company.)

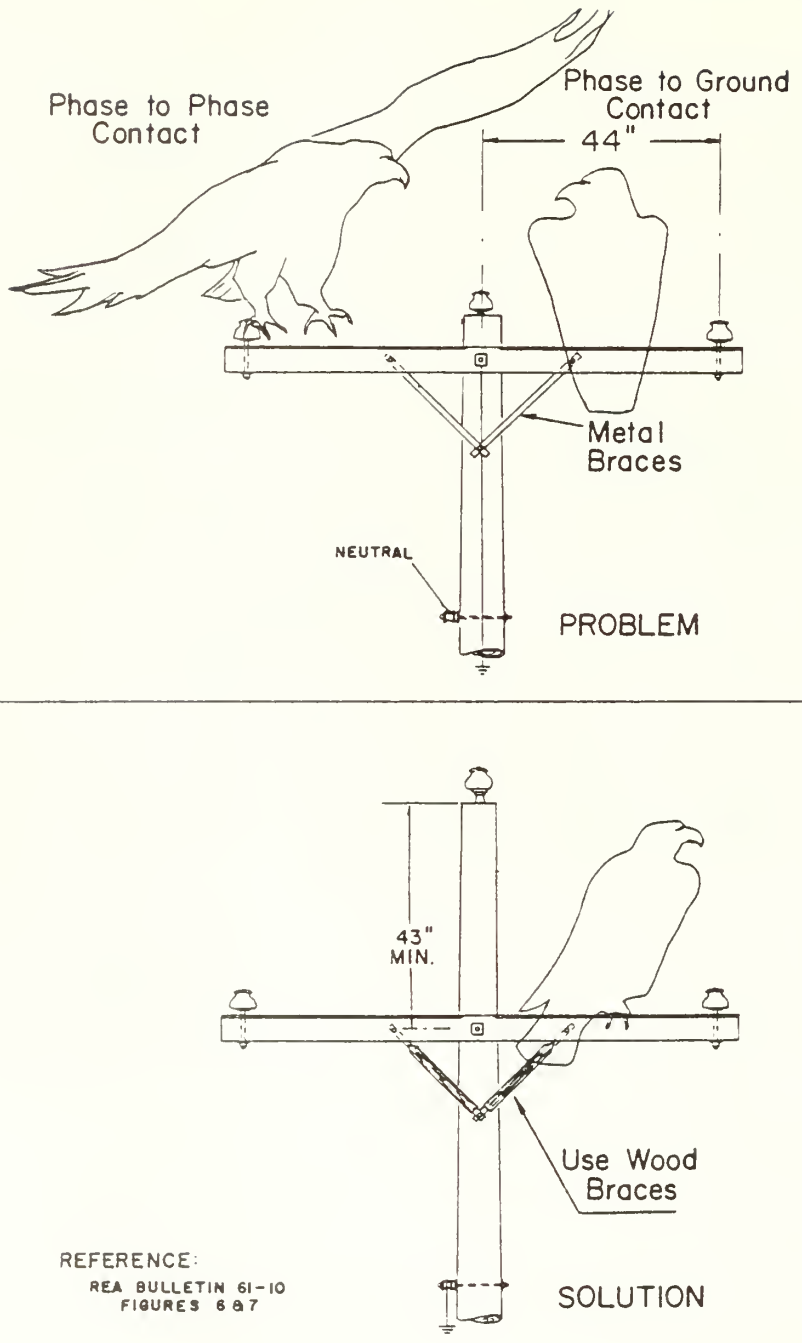


Figure 5. Vertical separation between the center conductor and two outside conductors eliminates the electrocution hazard.

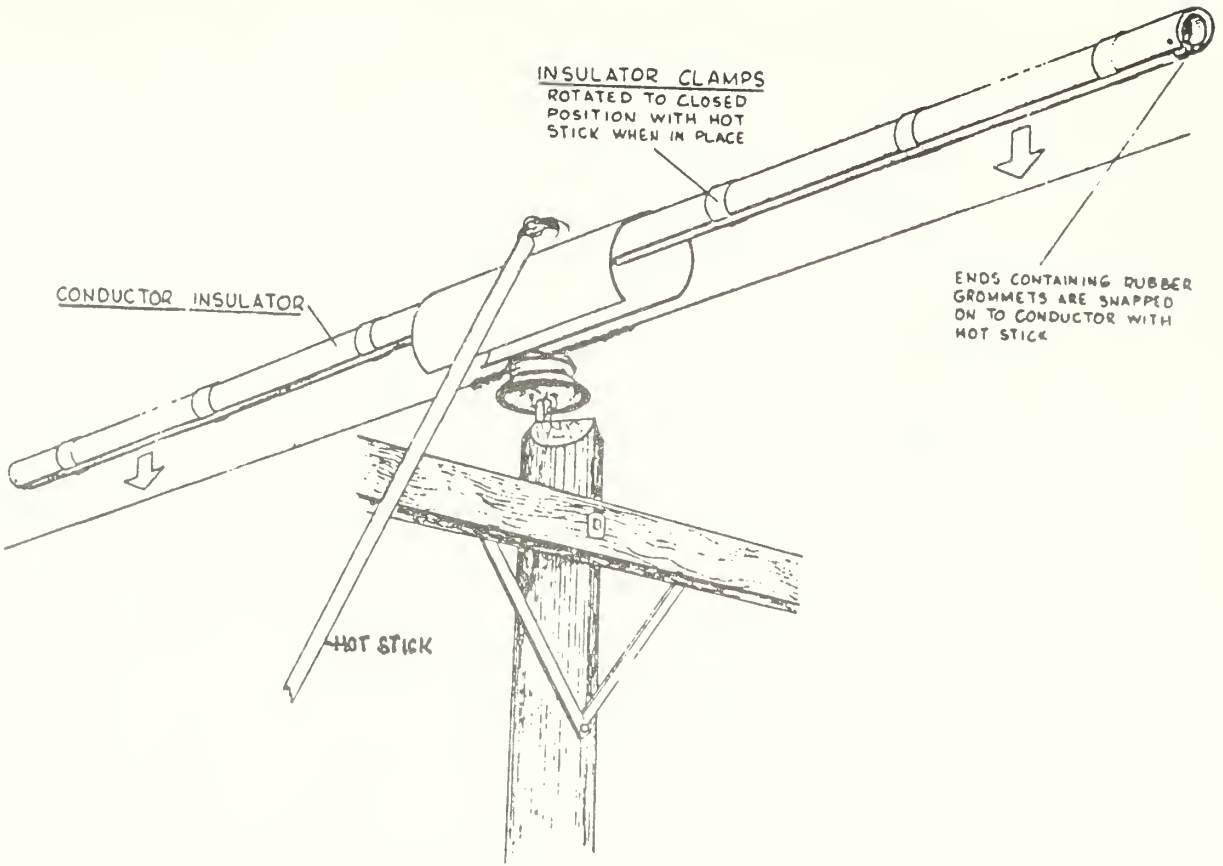

INSULATOR CLAMPS
ROTATED TO CLOSED POSITION WITH HOT STICK WHEN IN PLACE
CONDUCTOR INSULATOR
ENDS CONTAINING RUBBER GROMMETS ARE SNAPPED ON TO CONDUCTOR WITH HOT STICK
HOT STICK

Figure 6. A conductor insulation cover should be installed on poles used by eagles if pole reconstruction is impractical (Courtesy of Idaho Power Company).

necessary. Employ wood or plastic moulding when grounding is essential. Artificial perches mounted 91 cm (36 inches) above existing poles are an alternative to pole modification, suitable primarily for treeless regions (Fig. 7).

5. Search below powerlines for dead and injured eagles after major storms to monitor the effects of high voltage powerlines. If an electrocution victim is found, document the location and pole configuration by photographs if possible. Record the pole number and name of the power company and report the situation to a U.S. Fish and Wildlife Service official.

HUMAN DISTURBANCE

Bald eagles now share their winter habitat with fishermen, hunters, photographers, and birdwatchers. Roads, logging, and housing developments are planned for some wintering sites. Managers should minimize the effect of human disturbance on wintering bald eagles. The following guidelines should be helpful.

1. Discourage year-round development projects at bald eagle wintering sites. Wooded summer campgrounds and small farming operations are probably compatible with winter eagle use. Close campgrounds from November through March.

2. Prohibit recreational boat traffic at critical wintering sites, especially sanctuaries, during periods of eagle use.

3. Encourage birdwatchers and photographers to observe eagles only from vehicles or designated observation points. This minimizes disturbance to eagles and maximizes viewing opportunity.

4. Restrict bird watching and photographic activities to feeding sites where eagles are less easily disturbed. Close loafing and roosting areas to public use. Feeding activity of eagles is probably most interesting to sightseers.

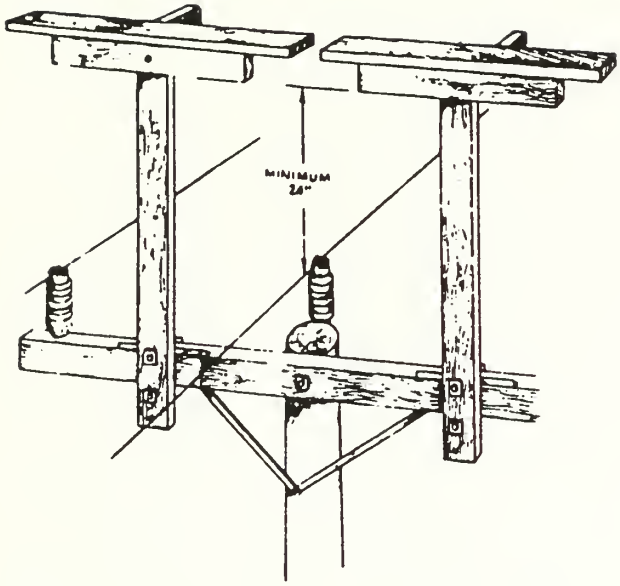
5. Restrict winter recreational activities to distances greater than 150 m (165 yd) from favored perches or shoreline, where possible.

6. Maintain dense understory vegetation or buffer zones within 30 m (33 yd) of the shoreline and other eagle use areas because such zones may reduce the effect of human disturbance.

7. Terminate logging, construction, and habitat improvement activities during periods of eagle use (15 October to 15 March usually). Farming and grazing activities rarely interfere with wintering eagles.

8. Encourage ice fishing, but restrict shore fishing to designated sites.

"T" Perch



Straight Perch

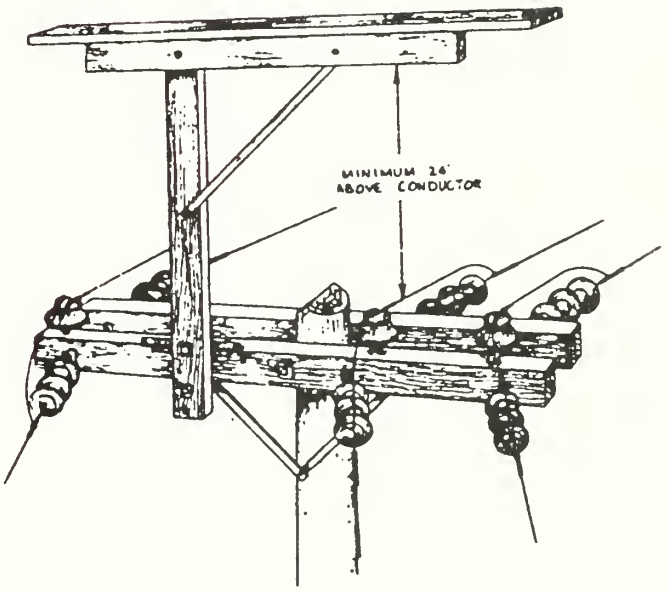


Figure 7. Artificial perches mounted above existing poles are an alternative to pole modification, suitable primarily for treeless regions.

9. Prohibit hunting in areas that are frequently or intensively used by eagles after 1 November. Earlier hunting seasons are not detrimental to wintering eagles and may provide a supplemental food source.

10. Establish signs and interpretive displays to inform the public about bald eagles and their habitat requirements. Encourage the public to visit sanctuaries during the summer months by establishing hiking trails and picnic areas.

LEGAL PROTECTION AND ENFORCEMENT

Leading causes of bald eagle mortality are illegal shooting and chemical contamination. Bald eagles and their remains are protected by the Bald Eagle Protection Act, the Migratory Bird Treaty Act, and certain regulations issued thereunder. These provisions prohibit the taking, possessing, bartering or transporting of any eagle or its parts, and provide for the prosecution of anyone violating these provisions; unless the action was in accordance with certain permit provisions. The Bald Eagle Protection Act defines the prohibited act of taking as including pursuing, shooting, shooting at, poisoning, wounding, killing, capturing, trapping, collecting, molesting or disturbing.

Bald eagles are also protected by the Endangered Species Act of 1973. Effective March 16, 1978, the subspecific southern bald eagle was deleted from the list of Endangered and Threatened Wildlife and Plants. Instead, all bald eagles are listed as Endangered through the 48 conterminous states of the United States, except in Washington, Oregon, Minnesota, Wisconsin, and Michigan, where they are listed as Threatened.

The legal status and protection of bald eagles and appropriate enforcement activities must be determined from the Bald Eagle Protection Act, the Migratory Bird Treaty Act, the Endangered Species Act of 1973, and the regulations, rules and exceptions established under these Acts. Managers of wintering sites can: assist in the protection and preservation of bald eagles; aid enforcement activities; and contribute needed information to research (Fig. 8), by observing the following guidelines.

1. Persons observing anyone disturbing, shooting, or molesting bald eagles should record the time, date, location, circumstances, and vehicle identification number. The incident should be reported immediately to the nearest U.S. Fish and Wildlife Service Special Agent (Appendix E). The National Wildlife Federation offers a reward for information leading to the conviction of violators of the Bald Eagle Protection Act. Also, the Eagle Protection Act allows a reward of up to half the monetary penalty levied for a violation of the Act, not to exceed $2500.

2. Persons finding dead eagles should record the time, date, location and circumstances and contact the nearest U.S. Fish and Wildlife Service Special Agent. A local Fish and Wildlife Service representative or State conservation official should be contacted if the Special Agent is unavailable. Carcasses should not be opened or dissected. If the carcas can be air shipped within 24 hours of discovery, it should be

Figure 8. Managers can assist law enforcement and research efforts by properly handling and reporting dead and injured eagles (photo by author).

immediately frozen. If there is cause to believe that a violation occurred, take steps to ensure the security of the carcass and all known or suspected information about the incident. If no violation is suspected, authorized persons should arrange for shipment to the National Fish and Wildlife Health Laboratory, Madison, Wisconsin. Contact the Diagnostic Laboratory, National Fish and Wildlife Health Laboratory (comm: 608-252-5422, FTS: 364-5422) for additional shipping instructions. This laboratory will also forward specimens to the Patuxent Wildlife Research Center for pesticide analysis. Feathers will be forwarded to Pocatello, Idaho for distribution to Indians.

3. Persons finding injured eagles should also contact a U.S. Fish and Wildlife Service Special Agent (or a State conservation official or local U.S. Fish and Wildlife Service employee if an agent is not available). Record the time, date, location, and circumstances during which the eagle was found. Only authorized persons should make arrangements to transport injured eagles to rehabilitation centers.

4. Cooperate in the prompt, accurate reporting of any banded, tagged, or color marked eagles that are found on wintering sites. Record the date, location, physical condition of the bird, and cause of death, if applicable. Photograph the plumage of the eagle, if possible. Notify a U.S. Fish and Wildlife Service Official or the Bird Banding Laboratory, Patuxent Wildlife Research Center, Laurel, Maryland 20811 (comm: 301-776-4880, FTS: 937-7221). Leave bands or tags on dead and injured eagles. If a carcass is destroyed bands or tags should be turned over to local Fish and Wildlife Service Personnel or forwarded to the Bird Banding Laboratory.

   Many banded bald eagles are of known age and geographic origin, and banded specimens are valuable in research. Skins of banded eagles should be preserved in major ornithological research collections. When authorized personnel transport banded birds or their remains, they should affix a label noting that the bird was banded so the specimen will be properly handled.

5. Special permits are required to trap, mark, or hold a bald eagle in captivity. Permits can be applied for from the Division of Law Enforcement, U.S. Fish and Wildlife Service Regional or Area Office. Persons wanting to possess eagle parts for religious or scientific purposes must apply to the same office.

INVENTORY

Inventory of wintering bald eagles can accomplish two goals. First, inventories can provide indices to regional and national population trends. Second, counts can provide information on annual and seasonal changes in numbers at a particular wintering site.

Winter inventories yield poor information about the productivity of bald eagle populations. Aerial counts may underestimate numbers of immature eagles (Hancock 1964). In addition, immature eagles use different habitats and different regions. Unless all habitats and regions are covered equally, distorted age ratios will result.

National bald eagle trends are presently assessed by three separate winter inventories. The U.S. Fish and Wildlife Service conducts midwinter eagle surveys in conjunction with waterfowl counts in early January of each year. Elton Fawks, Moline, Illinois, coordinates an annual one day count of eagles in the Mississippi River Valley region in mid-February. The National Audubon Society sponsors annual Christmas counts in December.

Land managers should provide compilers with complete and accurate counts. The following guidelines should be helpful.

1. Coordinate counts in nearby areas to avoid duplication and omission. Conduct all counts during the same week. Do not allow counts to overlap major storms that may be associated with eagle movements. The best nationwide and regional counts are conducted in early and mid-January when eagle migration is at a minimum.

2. At particular concentration sites, compare the results of aerial and ground counts. Use the most complete, repeatable, and economical method. The best inventory method will vary with the topography and accessibility of the site.

3. Use a combination of aerial and ground counts for regional surveys. Count eagles on long river stretches from fixed wing aircraft, and supplement aerial counts with more intensive ground observations at concentration sites.

4. Use randomly selected aerial or ground transects to derive an index to the number of eagles on upland areas.

5. Conduct ground counts from a car or pickup. Count from fixed observation points or along a count route. Avoid using boats to count eagles on narrow river stretches. Boats disturb eagles and may cause eagles to be counted more than once.

6. Do not conduct counts when fog or precipitation limits visibility or if winds exceed 16 km/hr (10 mph).

7. In general, counts are most successful around 1000 hours when birds are feeding and perched near a shoreline.

8. Counts of eagles entering and leaving a roost may also be useful if the entire roost and all routes of entry and departure are visible. Because many eagles use the roost during the day, counts of eagles returning to the roost alone are insufficient.

9. Use the same census method with the same number of observers (preferably the same observers) and cover the same area on each count.

SPECIES CHARACTERISTICS AND RANGE

The bald eagle (Haliaeetus leucocephalus) is the only North American representative of the fish or sea eagles (Grossman and Hamlet 1964) and is represented by two subspecies with overlapping winter ranges (American Ornithologists' Union 1957:113-114). The northern race, leucocephalus alascanus (formerly H. l. washingtonii) is generally larger than the southern race, leucocephalus leucocephalus, but most authors attribute the size difference to clinal variation (Bent 1937; Grewe 1966; Maestrelli and Wiemeyer 1975).

The winter range of the northern bald eagle extends from Alaska, northern Mackenzie, southern Ontario, southern Quebec, and southern Nova Scotia south through southern Oregon, Idaho, Wyoming, Colorado, South Dakota, Minnesota, Wisconsin, Michigan, Ohio, Pennsylvania, New Jersey, and Maryland (American Ornithologists' Union 1957:114). Recent information indicates that the northern subspecies winters south through Oklahoma (Lish and Lewis 1975), Texas (Dunstan 1973), Florida (Postupalsky 1976a), New Mexico, and Arizona (Boeker personal communication).

WINTER DISTRIBUTION

Bald eagles congregate at specific sites within the winter range (Fig. 9). Open water may be the most important feature of bald eagle wintering habitat (Brown and Amadon 1968; Snow 1973). Dams and national wildlife refuges provide open water habitat throughout the country (Imler and Kalmbach 1955; Spencer 1976). In the West, bald eagles also winter in arid valleys (Murphy 1975; Woffinden and Murphy 1975).

The largest wintering group of bald eagles is in Alaska where over 3,000 congregate in the Chilkat Valley during the fall and winter months. More than 1,000 eagles have been seen in the vicinity of Klukwan, Alaska during recent Audubon Society Christmas counts. Additional winter concentrations occur near Cordova, Sitka, Glacier Bay, Adak, and Kodiak Island in southern Alaska and the Aleutian Islands (Seventy-fifth Audubon Christmas Bird Count 1975). In Canada, bald eagles winter mainly in the coastal regions of British Columbia (Hancock 1964).

Approximately half of the bald eagles in the contiguous 48 states winter in a 12-state region in the Midwest (Sprunt and Cunningham 1961, 1962; Sprunt and Ligas 1963, 1966). This region includes the critical wintering areas in the Mississippi Valley (Pellett 1927; Musselman 1949; Fawks 1961; Pettingill 1963; Southern 1963, 1964; Ingram 1965). The Missouri River (Jonkel 1965; Grewe 1966; Russell 1968; Steenhof 1976), the Wisconsin River (Crehore 1974), the Platte River Valley (Weakly 1938; Vian 1971), and the Arkansas Valley also provide habitat for large eagle concentrations in the Midwest.

Figure 9. Primary winter distribution of the northern bald eagle.

Bald eagles on the Missouri River use tailwater areas below mainstem dams. Concentrations near man-made reservoirs also occur in Oklahoma and Kansas (Lish and Lewis 1975; Spencer 1976). The Wichita Mountains National Wildlife Refuge (Halloran 1959), and the Salt Plains National Wildlife Refuge (Van den Akker 1954) host large numbers of bald eagles in winter.

Eagles in the West congregate on major river systems and in isolated arid valleys (Sprunt and Cunningham 1961, 1962; Sprunt and Ligas 1963, 1966; Murphy 1975). Large numbers of eagles gather at Glacier National Park, Montana, in autumn (McClelland 1973; Shea 1973). The Skagit and Nooksack Rivers in Washington host many bald eagles each winter (Servheen 1975; Stalmaster 1976). In Idaho bald eagles utilize the Snake River Valley and portions of Lake Coeur d'Alene (Lint 1975). The San Luis Valley in Colorado and the Lower Klamath River Basin in northern California and southern Oregon are other major bald eagle wintering areas in the West (Krauss 1977; Stahlecker personal communication). In Utah, Montana, and Wyoming eagles use arid rangelands as well as river systems (Wrakestraw 1972, 1973; Murphy 1975; Spencer 1976). Bear River National Wildlife Refuge, Cedar Valley, and Rush Valley are important wintering sites in Utah (Swisher 1964; Edwards 1969).

The Eastern States host the fewest wintering bald eagles (Spencer 1976). Most eagles in the East winter in the Chesapeake Bay Region (Jacobsen 1947; Larson and Abbott 1962), but some eagles are found in Maine (Cammack 1975), Massachusetts, and New York (Spencer 1976). Southern bald eagles breed in Florida during the winter months.

RECENT CHANGES IN WINTER DISTRIBUTION

Many wintering concentrations of bald eagles are a recent phenomenon related to man's alteration of habitat (Sprunt and Ligas 1966). As dams were constructed on the Mississippi River between 1940 and 1950, eagle concentrations appeared near these sites. In Iowa, large concentrations of bald eagles along the Mississippi River were unknown before 1939 (Hodges 1959). At Hamilton, Illinois, the population of wintering eagles increased significantly after construction of the Keokuk Dam (Musselman 1949).

Prior to construction of mainstem dams on the Missouri River, the bald eagle was only a casual visitor to the upper Missouri Valley (Youngworth 1933). Now bald eagles regularly concentrate in large numbers below Missouri River dams in South Dakota (Grewe 1966) (Fig. 10). The distribution of wintering bald eagles in Maine was also altered by dams (Cammack 1975), and manmade reservoirs have created important new wintering habitat in Oklahoma (Cooksey 1962; Lish and Lewis 1975) and Nebraska (Shickley 1961). Although bald eagles have wintered on the Skagit River in Washington for almost a century, recent impoundments have caused changes in eagle distribution on the Skagit (Servheen 1975:24).

Concentrations not associated with dams have also become established recently. In 1960 large numbers of bald eagles began using an arid valley in western Utah (Edwards 1969). Increases may have been associated with more abundant jackrabbit carrion from highway kills and hunting (Platt 1976). In

Figure 10. The Fort Randall Dam in South Dakota is one of many dams that have altered the bald eagle's distribution.

Glacier National Park, Montana, eagle numbers have increased since 1939, especially since 1950 (McClelland 1973). Eagles at Glacier are attracted to spawning salmon that were first stocked in the area between 1916 and 1934 (Shea 1973).

WINTER MOVEMENTS

The specific nesting locations and migration pathways associated with wintering populations of bald eagles have not been determined (Fig. 11). A major portion of eagles wintering in the Midwestern States may come from Saskatchewan breeding grounds (Whitfield et al. 1974). Eagles from Saskatchewan also winter in Utah (Woffinden and Murphy 1975). Band returns indicate that the winter ranges of Wisconsin, Minnesota, Ontario, and Saskatchewan eagles overlap (Gerrard et al. 1975). Sprunt and Cunningham (1961) described three possible routes of migration: the Mississippi Valley, the Great Plains, and the Great Basin. Postupalsky (1976b) identified a migration route along the south shore of Lake Superior. In the West, eagles may move from Canada to Glacier National Park and then to Idaho and Utah (Lint 1975).

Eagles use most wintering sites from late October through March. Weather, photoperiod, and a shrinking food supply may stimulate eagles to move south. In the Midwest, immature eagles apparently migrate south earlier than adults (Sprunt and Ligas 1966). On the Mississippi River in northern Illinois, immature eagles outnumber adults in November and December, but after the southward migration adults outnumber immatures from January through March (Jonen 1973:10-19). Immatures comprise 20 to 25 percent of the population at Cassville, Wisconsin in early winter, but only 6 to 10 percent of the late winter eagle population are young birds (Ingram 1965). In South Dakota, immature bald eagles outnumber adults in November, but ratios level off to 20 to 40 percent immature during cold winter months after more adults arrive (Steenhof 1976).

The earlier migration of immature eagles apparently does not occur in the West. In Utah and Washington, adults arrive on the wintering grounds first with adults leaving Utah earliest in the spring (Edwards 1969:48; Servheen 1975:37; Stalmaster 1976:28). In British Columbia, adult/immature age ratios are constant through the winter (Hancock 1964).

Immature bald eagles apparently winter further south than adults (Sprunt and Cunningham 1962; Ingram 1965; Sprunt and Ligas 1966). The more northern wintering populations in Wisconsin (Ingram 1965), Illinois (Southern 1964), Idaho (Lint 1975), and South Dakota (Grewe 1966:13; Steenhof 1976:61) have consistently higher proportions of adult birds. However, immature eagles outnumber adults in Missouri (Southern 1974) and Oklahoma (Halloran 1959). The segregation between immature and adult birds in winter may be related to competition for food (Erskine 1968). In Washington, more immature eagles use the river systems where food supplies are greater (Stalmaster 1976:36).

Figure 11. The specific migration pathways of bald eagles have not been determined.

Bald eagle numbers fluctuate considerably at wintering sites. Sprunt and Cunningham (1961) identified a southward drift from September to late December and a reciprocal northward movement from late January to April. Eagles tend to winter farther south in colder winters (Sprunt and Ligas 1966). Eagle numbers at Hamilton, Illinois increase after the mean daily temperature drops below -12° C (10.4° F) (Jonen 1973:20-25). The first large influxes of eagles on a South Dakota wintering site occur when mean daily temperatures drop below -15° C (5° F) (Steenhof 1976:116).

Movements by eagles within and between wintering sites along major river systems are common, and some movement inland occurs as well (Southern 1963; Ingram 1965; Jonen 1973). In South Dakota, dispersal of bald eagles from concentration areas on the Missouri River is associated with changes in food supply and weather conditions (Jonkel 1965). South Dakota bald eagles use upland areas primarily after reservoirs freeze and after fish become unavailable from the river (Steenhof 1976). Eagles tend to disperse from rivers on clear, windy days with optimal thermals (Stalmaster 1976:27).

WINTER BEHAVIOR

Bald eagles roost communally throughout the winter range (Imler and Kalmback 1955; Ingram 1965; Edwards 1969:47; Jonen 1973; Shea 1973; Lish and Lewis 1975; Lint 1975; Servheen 1975; Stalmaster 1976; Steenhof 1976; Krauss 1977) (Fig. 12). Eagles may use as many as five communal roosts on a single wintering site (Edwards 1969:47; Ingram 1965). In some situations wintering eagles roost singly. Although bald eagles arrived on an Oklahoma wintering area in October, communal roosts were not used until December (Johnson 1961).

Eagles may move into the roost at 1400 hours or even as early as 1100 hours depending on weather and feeding success. During cold, stormy weather, eagles may stay in the roost all day (Cooksey 1962:19; Ingram 1965; Shea 1973:41; Lish and Lewis 1975). Utah eagles return to the roost in early afternoon, frequently flying several kilometers in slow, labored flight (Edwards 1969:80). Crehore (1974) reported direct flight of long lines of bald eagles heading for a Wisconsin roost.

Bald eagles leave Illinois communal roosts from daybreak to one half hour after sunrise (Jonen 1973:30). Utah eagles leave roosts as early as 1 hour and 50 minutes before sunrise (Platt 1976). Most eagles in South Dakota leave the roost in the half hour preceding sunrise; average time of earliest departure is 27 minutes before sunrise (Steenhof 1976:90). Eagles leave a Klamath Basin roost 30 minutes before sunrise (Krauss 1977). On cloudy or foggy mornings the movement from the roost occurs later (Jonen 1973:30). At one Illinois roost, immatures leave the roost earlier than adults (Bowes 1975). Most eagles move directly from the roost to feeding areas (Jonen 1973; Shea 1973; Dunstan 1974; Southern 1975; Platt 1976; Steenhof 1976). Flight is direct and alternated with a few short glides.

Eagles may remain perched at feeding sites for approximately 30 minutes before beginning to feed (Southern 1964). Winter fishing reaches a peak in Wisconsin between 0800 and 1000 hours, although some eagles will feed between

Figure 12. Bald eagles roost communally and congregate at feeding sites throughout the winter range.

1230 and 1400 hours (Ingram 1965). There is a bimodal feeding pattern with a second feeding period 1.5 hours before sunset in Illinois, Maine, Washington, and South Dakota (Grewe 1966; Dunstan 1974; Cammack 1975; Servheen 1975; Steenhof 1976).

The proportion of eagles that are feeding and searching for food in South Dakota decreases with increasing wind velocities, especially when winds exceed 15 km/hr (9.3 mph) (Steenhof 1976). Storms, high winds, or low temperatures may cause eagles to stay in the roost all day (Ingram 1965). Eagles at Grand Lake, Oklahoma stay in the roost during rain, snow, or heavily overcast periods (Cooksey 1962:15-16).

Eagles in Illinois remain on protected perches on foggy or snowy days, but on clear afternoons they will soar, especially if the wind is approximately 25 km/hr (15.5 mph) (Southern 1964). Jonen (1973:65) observed soaring activity in Illinois under wind conditions of 4.8 to 19.3 km/hr (3 to 12 mph). Most soaring in South Dakota occurs during wind velocities of 12.9 to 22.2 km/hr (8 to 13.8 mph) (Steenhof 1976:93). Utah eagles soar above canyon walls just before returning to the roost (Platt 1976).

Soaring activity may be related to pair formation (Ingram 1965). Toe-touching or talon-locking displays are common through the winter in Missouri (Southern 1974), but displays do not occur in South Dakota until March (Grewe 1966:27). The South Dakota soaring displays include as many as 30 eagles, and hawks sometimes join the soaring groups (Grewe 1966:27). In Wisconsin aerial displays begin in January and include soaring, chases, dives, and siderolls. Both immatures and adults participate in the displays. The frequency of displays increases in February, and they are most common during the northward migration (Ingram 1965).

Individual eagles may claim and defend perches on the wintering area (Cooksey 1962:17; Grewe 1966:27). Eagles occasionally supplant one another on limbs as they return to preferred positions in the roost before dark (Edwards 1969:78). Vocalizations are common as eagles arrive at the roost (Edwards 1969) and at feeding areas (Southern 1963, 1964; Shea 1973:49). A period of vocalization also follows the capture of prey (Shea 1973:49). Intraspecific aggression is common at a wintering area in Missouri (Southern 1974). Conflict is most common during feeding periods (Jonen 1973:75), and adults usually dominate immature birds in aggressive encounters (Erskine 1968; Stalmaster 1976:46).

In general, bald eagles exhibit very little hostility towards other species of birds (Shea 1973; Snow 1973). At an Oklahoma roost, a red-tailed hawk (Buteo jamaicensis) successfully incubated three eggs while bald eagles roosted within 1 m (1.09 yd) of the hawk nest (Cooksey 1962:28). Ravens (Corvus corax), golden eagles (Aquila chrysaetos), rough-legged hawks (Buteo lagopus), and ferruginous hawks (Buteo regalis) share roosting sites with bald eagles (Platt 1976; Steenhof 1976:111). Crows (Corvus brachyrhynchos), ravens and black-billed magpies (Pica pica) often feed simultaneously with bald eagles on wintering grounds (Southern 1963; Vian 1971; Platt 1976). Eagles are usually tolerant of crows in feeding situations but will chase or

lunge at crows if unduly harassed (Wright 1953; Erskine 1968; Southern 1974). In some areas hostile interactions between crows and eagles are common (Cammack 1975). Several species of gulls associate with bald eagles as both competitors and prey on the wintering grounds (Southern 1963; Jonen 1973); hostile and nonhostile encounters occur between gulls and eagles (Poor 1936; Southern 1974).

WINTER FOOD HABITS

The feeding habits of wintering bald eagles are diverse, changing with both season and region. Missouri and Mississippi River populations of bald eagles are predominantly fish eaters. Fish are the most important food for bald eagles in South Dakota (Grewe 1966; Steenhof 1976), Wisconsin (Ingram 1965; Crehore 1974), and Illinois (Southern 1963, 1964; Jonen 1973). Fish are also important to eagles wintering in the Pacific Northwest (Shea 1973; Servheen 1975; Stalmaster 1976). Great Basin eagles rely more on avian and mammalian carrion (Murphy 1976).

Fish

Bald eagles consume a variety of fish species during winter. The diet varies according to local differences in availability and vulnerability (Table 1).

The presence of a fishery does not ensure its attractiveness to bald eagles. Eagles depend primarily on fish that are dead, dying, or otherwise vulnerable. Eagles at Cassville, Wisconsin feed on fish that are killed by powerplant operations (Ingram 1965) (Fig. 13). Winterkilled fish provide food for bald eagles throughout the country when ice thaws (Southern 1974; Spencer 1976; Steenhof 1976).

Eagles prefer to fish in shallow waters where fish are more vulnerable (Spencer 1976). In deeper waters, surface feeding fish are probably more vulnerable to eagles than bottom dwellers. The proportion of goldeye, a surface feeding species, in the diet of South Dakota eagles exceeds the relative proportions of goldeye in the Missouri River. In contrast, bottom dwellers like blue sucker (Cycleptus elongatus), shorthead redhorse (Moxostoma breviceps), bigmouth buffalo (Ictiobus cyprinellus), and sauger are less available to eagles (Steenhof 1976).

Gizzard shad may be the most important prey species in both Illinois and South Dakota (Southern 1963, 1964; Grewe 1966:19; Jonen 1973), and shad may be the primary prey species of wintering bald eagles throughout the Midwest (Dunstan 1974). Shad are a readily available food source because they commonly die in large numbers in winter. Annual die-offs of young shad throughout the country are associated with low temperatures, low dissolved oxygen, and sudden changes in current (Southern 1963; Spencer 1976).

Eagles feed on young-of-the-year shad and white bass during a restricted period of declining water temperatures at Fort Randall Dam, South Dakota. The decreasing temperatures cause fish to weaken, seek deeper water, and

Table 1. Fish species utilized by wintering bald eagles.

Geographic Area	Fish Species	Reference
Illinois	gizzard shad (Dorosoma cepedianum) carp (Cyprinus carpio) buffalo (Ictiobus sp.) catfish (Ictalurus sp.) white bass (Roccus chrysops)	Southern 1963, 1964 Jonen 1973
South Dakota	gizzard shad carp white bass goldeye (Hiodon alosoides) channel catfish (Ictalurus punctatus) paddlefish (Polyodon spathula) yellow perch (Perca flavescens) crappie (Pomoxis sp.) gar (Lepisosteus sp.) walleye (Stizostedion vitreum) sauger (Stizostedion canadense)	Grewe 1966:20 Steenhof 1976:97
Utah	carp walleye	Edwards 1969:93
Oklahoma	gizzard shad	Lish and Lewis 1975
Nebraska	gizzard shad	Vian 1971
Glacier National Park, Montana	kokanee salmon (Oncorhynchus nerka)	Shea 1973
Lake Coeur D'Alene, Idaho	kokanee salmon	Lint 1975
Washington	chum salmon (Oncorhynchus keta) coho salmon (Oncorhynchus kisutch) pink salmon (Oncorhynchus gorbuscha) chinook salmon (Oncorhynchus tshawytcha)	Servheen 1975 Stalmaster 1976

Figure 13. Powerplants on the Mississippi River provide wintering bald eagles with a supply of dead and dying fish.

become pulled through dam turbines. Dead and injured shad and bass are then available to eagles in the tailwaters. The proportion of shad and bass in the eagle diet is related to the relative reproductive success of the respective fish species in the previous spring (Steenhof 1976).

Stranded fish are a common food item of wintering bald eagles (Spencer 1976). Bald eagles in the Pacific Northwest utilize stranded spawned out salmon. Eagle numbers at wintering sites are directly related to spawning runs, and eagles do not utilize live salmon (Servheen 1975; Stalmaster 1976). Wide braided river stretches with numerous gravel bars retain stranded salmon carcasses, and eagle densities are highest along these stretches. In contrast, tributaries and mainstem streams wash away carcasses and provide little food for eagles (Stalmaster 1976:43). Eagles rarely consume salmon carcasses on gravel bars with heavy foliage (Stalmaster 1976:45; Servheen 1975:57).

Fluctuations in water release rates from the Fort Randall Dam caused fish to be stranded daily in South Dakota. Low river levels attracted eagles to pools of receding water on sandbars. Apparently fish seek deeper water and are not susceptible to stranding when water temperatures drop below 7^{o} C (45^{o} F) (Steenhof 1976).

Fish consumed by wintering bald eagles range from 7 to 45 cm (2.8 to 17.7 inches) in length (Table 2). Weights range from 10 to 1200 g (0.02 to 2.6 lb) (Southern 1964; Steenhof 1976). Eagles carry the larger 900 to 1200 g (2.0 to 2.6 lb) fish to remote perches (Southern 1964) but swallow the smaller fish in flight (Ingram 1965; Steenhof 1976). Shea (1973) estimated that Montana eagles consume six 30 cm (11.8 inch) salmon per day during salmon abundance.

Southern (1963) described four conventional fishing methods used by wintering bald eagles in Illinois: 1) swooping from a perch; 2) swooping from air; 3) reaching from the edge of ice with talons; and 4) wading. Wintering bald eagles also steal food items from common mergansers (Mergus merganser), ring-billed gulls (Larus delawarensis), great black-backed gulls (Larus marinus), crows, and other bald eagles (Grubb 1971; Cooksey 1962; Erskine 1968; Jonen 1973; Southern 1963). Immature eagles swoop for fish less frequently than adults. Young birds tend to steal fish, pick up fish from the ground, and wade for fish more often than adults (Shea 1973:46).

Birds

Waterfowl and other birds are secondary or unimportant food items for bald eagles where fish are abundant, (Grewe 1966:21-23; Servheen 1975:67; Stalmaster 1976:46). In Oklahoma and South Dakota, waterfowl become a more important food as winter progresses (Lish and Lewis 1975; Steenhof 1976). Wintering bald eagles in Idaho increase their consumption of waterfowl when salmon supplies dwindle (Lint 1975). A population of bald eagles in New Brunswick subsists primarily on fish and carrion in the summer but switches to a waterfowl diet in winter (Wright 1953).

Table 2. Sizes of fish used by wintering bald eagles.

Geographic Area	Fish Size	Reference
Wisconsin River	7-13 cm (2.8-5.1 inches)	Crehore 1974
Savannah, Illinois	7-10 cm (2.8-3.9 inches)[a]	Southern 1963, 1964
Hamilton, Illinois	10-15 cm (3.9-5.9 inches)	Jonen 1973, p. 38
Pickstown, South Dakota	11-45 cm (4.3-17.7 inches)[b] 10-800 g (0.02-1.8 lb.)	Steenhof 1976, p. 98
Salt River, Oklahoma	10-25 cm (3.9-9.8 inches)	Lish 1975
Glacier National Park, Montana	30 cm (11.8 inches)	Shea 1973

[a]Shad

[b]Weights and lengths average 263 g (0.58 lb.) and 28.4 cm (11.2 inches).

At heavily hunted waterfowl concentration areas, however, bald eagles are attracted to the abundance of crippled waterfowl and feed almost exclusively on avian carrion (Southern 1974; Griffin personal communication) (Fig. 14). Waterfowl are the primary food of wintering bald eagles at Bear River, Swan Lake, and Squaw Creek National Wildlife Refuges (Swisher 1964; Griffin, Ingram, personal communication). Wintering bald eagles in British Columbia and at Klamath Basin, Oregon also prey on ducks (Munro 1938; Krauss 1977).

Waterfowl utilized by bald eagles include Canada geese (Branta canadensis), mallards (Anas platyrhynchos), pintails (Anas acuta), canvasbacks (Aythya valisineria), common mergansers, common goldeneyes (Bucephala clangula), shovelers (Anas clypeata), and lesser scaups (Aythya affinis) (Grewe 1966; Southern 1974; Lish and Lewis 1975; Steenhof 1976).

Coots (Fulica americana), ring-necked pheasants (Phasianus colchicus), common crows, black-billed magpies, ring-billed gulls, meadowlarks (Sturnella sp.), and red-winged blackbirds (Agelaius phoeniceus) are also consumed by wintering bald eagles (Jonen 1973:51; Lish and Lewis 1975; Platt 1976; Steenhof 1976).

Bald eagles may be inefficient predators of healthy birds. Jonen (1973:46) witnessed more than 40 unsuccessful attacks by eagles on common goldeneyes, and Southern (1964) recorded the unsuccessful attempt of several eagles to capture a healthy mallard. In British Columbia, Hancock (1964) observed 85 unsuccessful passes at crippled waterfowl. None of the strikes were successful, and no passes were made at healthy birds. Crippled gulls and coots have also escaped attempted eagle predation (Wright 1953; Bender 1960).

Most birds taken by bald eagles are probably in a weakened or dying condition. Only a few investigators have observed bald eagles killing live waterfowl. In one study, 60 percent of bald eagle cast pellets that contained waterfowl remains also contained lead shot (Dunstan 1974). It is likely that eagles prey more heavily on cripples than healthy birds. Numerous observations have also been made of wintering bald eagles feeding on the carcasses of waterfowl that have died from lead poisoning, duck plague, and avian cholera (Friend, personal communication).

A relatively small population of waterfowl can support substantial numbers of wintering bald eagles. Approximately 40 eagles were sustained during the late winter in southeastern South Dakota by 5,000 mallards and 5000 Canada geese, with no measurable change in waterfowl population.

Mammals

Wintering bald eagles also consume mammals. In the Gulf Islands, British Columbia, dead sheep are the main food item (Hancock 1964). Bald eagles also feed on carcasses of white-tailed deer (Odocoileus virginianus) (Erskine 1968; Steenhof 1976) and black-tailed deer (Odocoileus hemionus)

Figure 14. Winter waterfowl concentrations attract both eagles and hunters, and eagles feed on abundant avian carrion in these areas (U.S Fish and Wildlife Service photo).

(Servheen 1975; Stalmaster 1976). Black-tailed jackrabbits (Lepus californicus) comprise a primary food source for bald eagles wintering in western Kansas (Imler 1937) and western Utah (Edwards 1969:89; Woffinden and Murphy 1975; Platt 1976).

Washington eagles use carrion away from the Skagit River only when riverine food supplies are unavailable (Servheen 1975). Coyote (Canis latrans), deer, and domestic cow carrion are an important supplemental food source in Washington, especially towards the end of winter when salmon supplies have dwindled. In fact, eagle distribution on the Nooksack is partially determined by deer carcass distribution (Stalmaster 1976:46).

Cast pellets from wintering populations in Illinois, Oklahoma, Utah, and South Dakota contain several mammalian species, many of which probably represent carrion. Pellets have contained remains of easter cottontail (Sylvilagus floridanus), black-tailed jackrabbit, white-tailed deer, fox squirrel (Sciurus niger), black-tailed prairie dog (Cynomys ludovicianus), ground squirrel (Spermophilus sp.), opossum (Didelphis marsupialis), plains pocket gopher (Geomys bursarius), kangaroo rat (Dipodomys ordii), wood rat (Neotoma floridana), deer mouse (Peromyscus maniculatus), vole (Microtus sp.), and domestic pig, sheep, and cattle (Jonen 1973:51-51; Lish and Lewis 1975; Platt 1976; Steenhof 1976).

Bald eagles have rarely been observed killing mammalian prey. Most cast pellets from Utah that contained rabbit remains also contained lead shot and gravel. This suggests that most rabbits consumed by bald eagles are killed by hunters or cars (Platt 1976). Bald eagles also scavenge mammalian prey from golden eagle kills (Platt 1976; Stahlecker personal communication).

WINTERING HABITAT

Diurnal Perches

Eagles perch on trees, rock outcrops, logs, pilings, driftwood, ice, the ground, haystacks, powerline poles, and fenceposts (Cooksey 1962:16; Southern 1963, 1964; Ingram 1965; Vian 1971:44; Shea 1973:42; Lint 1975; Steenhof 1976; Krauss 1977). Eagles prefer tree perches over other types (Lish 1975:32; Steenhof 1976), and eagles consistently use preferred perch trees and branches (Southern 1963; Ingram 1965; Grewe 1966; Shea 1973:41; Stalmaster 1976:52).

Proximity to a food source is probably the most important factor influencing perch selection by eagles (Steenhof 1976; Stalmaster 1976). Favorite trees are invariably located near feeding areas and may be used for 75 to 83 percent of the daylight hours (Ingram 1965; Vian 1971; Servheen 1975; Stalmaster 1976:47). Three adjacent cottonwood stands on a South Dakota wintering site have similar tree dimensions, but only the stand adjacent to the riverbank and nearest the food source is used by eagles (Steenhof 1976).

Ninety-four percent of eagles on the Missouri River floodplain in South Dakota perch within 30 m (33 yd) of the river. Eighty-six percent perch within 15 m (16 yd) of the bank, and 58 percent perch within 5 m (5 yd) of the bank (Steenhof 1976). Of 400 bald eagle sightings in Nebraska, only 15 were farther than 182 m (200 yd) from the Platte River (Vian 1971:46). Glacier National Park eagles also prefer perches near the edge of streams (Shea 1973:41-42).

Most tree perches selected by eagles are bordered by open area. Eagles use perches that provide a good view of the surrounding area (Cooksey 1962:16; Vian 1971:43; Servheen 1975; Stalmaster 1976:47; Krauss 1977), and edge situations provide both visibility and accessibility. Exposure to the sun may also help to reduce heat loss (Dunstan 1974).

Eighty-two percent of tree perches used by South Dakota eagles are bordered by at least one edge type, and 27 percent are bordered by two edge types. The riverbank is the most important edge. Rangeland, cropland, creeks and roads also form important edge situations. Most perches not bordered by open area are surrounded by smaller trees (Steenhof 1976). Eagle perches in Nebraska are rarely located in dense woody growth (Vian 1971:43).

Tree height also provides visibility and accessibility. Bald eagles tend to use the highest perch sites available (Lint 1975; Stalmaster 1976). Trees used by eagles are usually taller than average. The mean height of trees used by eagles on the Missouri River floodplain is 21.1 m (69.3 ft), and the mean height of trees on the floodplain is only 13.6 m (44.6 ft) (Steenhof 1976).

Trees used by eagles also tend to have large diameters. Mean diameter of trees used by eagles in South Dakota is 42.3 cm (16.7 inches), and the mean diameter of all trees on the wintering site is only 27.8 cm (11 inches) (Steenhof 1976). Selection for large diameter is partially related to selection for height, but stout, sturdy trees are also necessary to support an eagle's weight (Vian 1971:43). Tree perching eagles tend to select stout, horizontal branches, especially those extending over open areas (Steenhof 1976). These branches provide both strength and visibility (Figure 15).

Diurnal perch trees used by wintering bald eagles include western larch (Larix occidentalis), Engelmann spruce (Picea engelmannii), western redcedar (Thuja plicate), black cottonwood (Populus trichocarpa), plains cottonwood (Populus deltoides), douglas fir (Pseudotsuga menziesii), boxelder (Acer negundo), American elm (Ulmus americana), green ash (Fraxinus pennsylvanicus), peach-leaved willow (Salix amygdaloides), hackberry (Celtis occidentalis), eastern redcedar (Juniperus virginianus), bigleaf maple (Acer macrophyllum), white oak (Quercus alba), red oak (Quercus borealis), sycamore (Platanus occidentalis), Ponderosa pine (Pinus ponderosa), western white pine (Pinus monticola), sitka spruce (Picea sitchensis), red alder (Alnus rubra), grand fir (Abies grandis), paper birch (Betula papyrifera), western hemlock (Tsuga heterophylla), and cypress (Taxodium distichum) (Cooksey 1962:16; Southern 1964; Vian 1971:43; Shea 1973:41-42; Lint 1975; Lish 1975; Stalmaster 1976:48; Steenhof 1976:73).

Figure 15. A typical diurnal perch tree is large, is surrounded by open area and contains many stout, horizontal branches.

Although eagles use a variety of tree species, they prefer some species over others. Species preference is determined partially by regional variation in species availability.

Eagle preference for cottonwoods in South Dakota is related to the tendency for cottonwoods to occur near the riverbank. Size and growth form of cottonwoods also make them exceptionally suitable as eagle perches (Steenhof 1976:72).

Eagles in Washington prefer bigtooth maple because of its large size and growth form. Sitka spruce is preferred by eagles because of its proximity to water and its tallness. Other conifers are avoided by eagles probably because the foliage obscures vision. Red alder is utilized less than expected because of its low height, and eagles use black cottonwood more than expected because of its tall height (Stalmaster 1976:49).

Dead trees are preferred by eagles in some areas (Vian 1971:43; Lish and Lewis 1975; Stalmaster 1976), but eagles readily use living trees when dead trees are not available (Shea 1973:41-42; Steenhof 1976). Diurnal eagle perches at Grand Lake, Oklahoma are usually in dead oak, dead limbs at the tops of living oaks, or in live cedars (Cooksey 1962:16). Dead trees (Figure 16) provide unobstructed views and are sometimes taller than surrounding vegetation (Stalmaster 1976:49).

The importance of artificial poles to wintering bald eagles is questionable. Bald eagles in Oklahoma, South Dakota, and Colorado avoid utility pole perches in winter (Lish 1975; Steenhof 1976; Stahlecker personal communication), and Nebraska eagles rarely use powerline poles (Vian 1971:44). In treeless regions of Utah, however, bald eagles regularly perch on fenceposts and telephone poles (Platt 1976). Artificial perches designed for eagles in South Dakota and Oregon have been only partially suceessful (Steenhof 1976; Opp, personal communication).

The U.S. Army Corps of Engineers erected four single pole perches with crossarms (9 m (30 ft) high; 20 cm (8 inches) diameter) on the Missouri River floodplain below Fort Randall Dam, South Dakota (Figure 17). Although the poles were within 10 m (33 ft) of the riverbank, near feeding areas, and bordered by rangeland, no eagles used the perches the first winter (Steenhof 1976), and only two sightings of eagles on the perches were recorded the following winter (Smith, personal communication). More than 20 eagles regularly perch in surrounding trees during winter (Steenhof 1976).

A tripod perch (18 m (60 ft) high) constructed near an eagle feeding area on the bank of the Upper Klamath River, Oregon (Figure 18) was slightly more successful. The perch was designed as a substitute for a stand of cottonwoods destroyed by beavers. Although eagles did not use the perch during the first winter, as many as seven utilized it the second year. The number of eagles using the artificial perch, however, has been lower than the number that used the original cottonwoods. Eagles have since shifted use to smaller trees and snags near the artificial perch (Opp, personal communication).

Figure 16. Eagles prefer tall snags in some areas because dead trees provide both visibility and accessibility (U.S. Fish and Wildlife Service photo).

Figure 17. Single pole eagle perch on the Missouri River, South Dakota (photo by author).

Figure 18. Tripod eagle perch on the Upper Klamath River, Oregon. (Photo by Jeff Lincer, Raptor Information Center, National Wildlife Federation).

Roosting Habitat

Night roosting habitat requirements are different from those of diurnal perches. For example, proximity to water is not a major requirement of roosting sites. Glacier National Park eagles roost in stands approximately 3 km (2 mi) from feeding areas and 0 to 0.8 km (0 to 0.5 mi) from lakeshore (Shea 1973:40-41). Klamath Basin roosts are 16 km (10 mi) from Klamath Lake (Krauss 1977). Oklahoma roosts are usually within 1 km (0.6 mi) of a major river or reservoir, and eagles seldom range more than 5 km (3 mi) from the roost (Lish and Lewis 1975). Wisconsin eagles move at least 16 km (10 mi) between roosting and feeding areas (Ingram 1965), and one Utah roost is 28.7 km (17.8 mi) from the nearest feeding area (Swisher 1964). In Washington, communal roosts are 0.8 km (0.5 mi) from the Nooksack River (Stalmaster 1976:41).

Most winter roosts used by bald eagles are well protected from wind. Roosts on the Illinois River are on east-facing slopes that are protected from prevailing westerly winds (Bowes 1975). Eagles at Grand Lake, Oklahoma roost in a wind-protected valley (Cooksey 1962:22-26). Secluded side canyons provide wind protection for roosting Utah eagles (Swisher 1964; Edwards 1969:46). Klamath Basin roosts offer protection from inclement weather because they consist of dense timber in bowl shaped depressions (Krauss 1977). Coniferous roosting stands in Washington provide eagles a sheltered microhabitat and protection from chilling winds and rain (Stalmaster 1976:49). A roost in South Dakota, 75 m from the riverbank, is protected from wind by a stand of smaller trees adjacent to the bank. The roost appears to be the most protected stand on the wintering site, and eagles consistently use the roost during severe windchill conditions and high wind velocities (Steenhof 1976).

On the Mississippi River, eagles in Illinois and Wisconsin choose roosts according to weather conditions. Eagles roost in stands adjacent to the riverbank on warm nights but move to more protected valley roosts on colder nights (Dunstan 1974; Ingram personal communication). Eagles in Utah also prefer the more protected mountain roosts during storms and high winds (Edwards 1969; Platt 1976).

Bald eagles roost in a variety of tree species throughout the winter range. Cottonwoods are the most important roosting trees in South Dakota and Oklahoma (Lish and Lewis 1975; Steenhof 1976). Oklahoma eagles also roost in blackjack oak (Quercus marilandica), sycamore, shortleaf pine (Pinus echinata), American elm, and blue ash (Fraxinus quadrangulata) (Lish 1975; Lish and Lewis 1975). Roosts in Utah are in Douglas fir and introduced black willow (Salix nigra) (Swisher 1964; Edwards 1969:46; Platt 1976). Eagles in Glacier National Park roost in black cottonwoods and western larch. Oak and silver maple (Acer saccharinum) comprise Illinois winter roosts (Dunstan 1974). Eagles roost in oaks and cottonwoods in Wisconsin (Ingram personal communication). Idaho eagles roost in western white pine and western larch (Lint 1975); and Klamath Basin eagles roost in ponderosa pine (Krauss 1977).

Roost trees are generally larger than most diurnal perches (Steenhof 1976). Eagles tend to roost in the largest rees on the wintering site (Steenhof 1976), and they prefer the largest trees in the roost (Lish and Lewis 1975; Krauss 1977). Average diameters of roost trees range from 45.0 to 106.6 cm (17.7 to 42.0 inches), and average heights range from 12.5 to 30.0 m (41 to 98 ft) (Table 3).

Fifty-seven percent of roost trees in Oklahoma are alive; 14 percent are dying; and 29 percent are dead. Eagles consistently roost in one dead tree apparently because there are no small branches to interfere with landing (Lish and Lewis 1975). Eagles in Klamath Basin prefer both living and dead trees that have an open branching pattern in the top half of the tree (Figure 19) (Krauss 1977). Roost trees in Illinois have easily accessible limbs (Bowes 1975), and Utah roosting trees are large and open with sufficient room for take-off and landing (Edwards 1969:17).

An opening formed by an old river channel separates live cottonwood roosting trees from trees on the river in South Dakota. The opening apparently makes roost perches easily accessible to eagles; most of the roost perches are stout, horizontal branches extending over the channel opening (Figure 20) (Steenhof 1976:66). Similarly, other roosts in South Dakota, Oklahoma and Washington are bordered by open area formed by cropland, clearcuts, and lakeshore (Lish 1975:39-41; Stalmaster 1976:41; Steenhof 1976:66). Seventeen percent of 77 mature cottonwoods in a South Dakota roost have two or more forks at the trunk. Eagles prefer the forked trees because they form stout, horizontal perches extending over open areas (Steenhof 1976:66).

Roosting stand densities in California are 57 and 170 trees per ha (23 and 69 per acre). Klamath Basin eagles roost in large 12.5 ha (30 acre) timber stands, but eagles probably use only a fraction of the trees present (Krauss 1977). Some communal roosts in Oklahoma consist of a single tree. Other roosts in Oklahoma and South Dakota contain 30 to 77 trees and cover 0.4 to 5.0 ha (1 to 12 acres) (Lish 1975; Steenhof 1976). Eagles repeatedly select the same roosting perches for more than six years (Platt 1976).

POWERLINES

Powerline accidents can cause eagle deaths and injuries (Figure 21), especially in the West. Eagles can be electrocuted on single poles with crossarm construction when the wing contacts either two phase conductors or a phase conductor and a ground wire. Accidents are most likely to occur on poles that provide a good view of the surrounding terrain and on crossarms that are crosswise to prevailing winds. It is likely that 95 percent of all electrocutions occur on only two percent of all poles (Nelson and Nelson 1975). Electrocution is not a problem on high voltage lines with more widely spaced wires and phase conductors, but impact with high voltage wires can kill or injure large birds of prey.

Figure 19. Eagles prefer roost trees with open horizontal branches

Figure 20. An opening makes South Dakota roost trees accessible to eagles. Eagles prefer the horizontal branches extending over the opening.

Figure 21. Powerlines can be a significant cause of eagle mortality.

Table 3. Dimensions of trees in bald eagle winter roosts.

Location	Tree species	Mean height m (ft)	Mean diameter cm (inches)	Reference
South Dakota				Steenhof 1976
Missouri River floodplain	cottonwood	27.8 (91)	52.1 (20.5)	
Lake Andes	cottonwood	18.0 (59)	50.4 (19.8)	
Oklahoma				Lish and Lewis 1975
Salt Fork River A	cottonwood	19.1 (63)	76.2 (30.0)	
Salt Fork River B	cottonwood	16.9 (55)	73.6 (29.0)	
Salt Fork River C	cottonwood	21.5 (71)	106.6 (42.0)	
Salt Fork River D	cottonwood	25.0 (82)	70.0 (27.6)	
Salt Fork River E	cottonwood	30.0 (98)	80.0 (31.5)	
Texas County 1	cottonwood	20.0 (66)	60.0 (23.6)	
Texas County 2	cottonwood	20.0 (66)	60.0 (23.6)	
Wichita Mountains NWR	oak	12.5 (41)	52.5 (20.7)	
Sequoyah NWR 1	cottonwood	30.0 (98)	105.0 (41.3)	
Sequoyah NWR 2	sycamore	25.0 (82)	85.0 (33.5)	
Cookson Refuge	oak	20.0 (66)	60.0 (23.6)	
Grand Lake	shortleaf pine	27.5 (90)	52.5 (20.7)	
Osage County	American elm	15.0 (49)	60.0 (23.6)	
Fort Gibson	blue ash	24.0 (79)	45.0 (17.7)	
California				Krauss 1977
Three Sisters	Ponderosa pine	25.6 (84)	50.3 (19.8)	
Caldwell-Cougar	Ponderosa pine	14.3 (47)	46.2 (18.2)	

Ninety percent of all electrocution victims are golden eagles (Raptor Research Foundation 1975), but bald eagles also die from electrocution and powerline impact injures (Coon et al. 1970; Vian 1971:38). Raptor electrocutions occur primarily during winter when eagles concentrate near human developments. Eagles are more susceptible to electrocution in flat, broad valleys where natural perches are not available (Raptor Research Foundation 1975). Young eagles are probably more susceptible to powerline injuries than adults. Most collisions with high voltage wires occur during strong winds and poor light conditions.

HUMAN DISTURBANCE

Human activity sometimes conflicts with eagle use of wintering areas, causing eagles to abandon favorable sites. Eagles in South Dakota and Washington prefer areas with lower recreational activity. On the Nooksack and Skagit Rivers, eagles consistently use the bank with the least human activity (Servheen 1975; Stalmaster 1976:55). After part of a South Dakota campground was closed to the public, eagles increased their use of the closed section but decreased use of the section that remained open to public activity (Steenhof 1976:86-88). Eagles readily approach man-made structures when there is no human activity nearby (Vian 1971:46). However, a housing development on Grand Lake, Oklahoma apparently caused eagles to abandon a nearby winter roost (Lish 1975).

Eagles use some moderately disturbed sites because food supplies tend to be more abundant in these areas. They tolerate more disturbance at feeding sites than at loafing or roosting areas (Lish 1975:28; Stalmaster 1976; Steenhof 1976), and immature eagles tolerate human disturbances more readily than adults (Stalmaster 1976).

Eagles in Nebraska become alarmed by the presence of humans within 800 m (875 yd) (Vian 1971:46). Stalmaster calculated that 98 percent of wintering bald eagles will tolerate human activities 300 m (328 yd) from them. However, only 50 percent of eagles tolerate disturbances at distances of 150 m (164 yds).

Automobile traffic is one of the least disturbing human activities. Eagles apparently become conditioned to cars (Stalmaster 1976:72). In South Dakota an average of 80 cars per day pass within 34 m (37 yd) of a preferred eagle perch. Eagles regularly use this tree during winter, and as many as 20 birds use the perch at one time (Steenhof 1976).

Airplanes flying at altitudes of 30 to 90 m (100-300 ft) above wintering sites rarely disturb eagles (Krauss 1977). Boat and snowmobile traffic, on the other hand, are serious disturbing influences (Ingram 1965). Eagles avoided an entire section of 9 wintering sites in South Dakota when fishermen used boats in the area (Steenhof 1976). In Washington, both motorboats and drift boats disrupt eagle activity patterns (Stalmaster 1976).

Ice fishing and shore fishing can disturb eagles (Stalmaster 1976). Mobility of ice fishermen, however, is restricted, and eagles frequently use nearby areas that are inaccessible from ice. Ice fishing can sometimes provide a supplemental food source for eagles when fishermen discard trash fish (Southern 1963; Ingram personal communication).

Pedestrians are more disturbing than cars but less disturbing than boats. Heavy vegetation may reduce the disturbing effect of foot traffic, because eagles are more readily flushed by exposed hikers (Stalmaster 1976).

Minor auditory disturbances alone do not seriously disturb eagles. Gunshots, however, usually cause eagles to leave an area (Stalmaster 1976:69). Early morning activities of deer hunters in a winter roost forced eagles to abandon their traditional roost site in South Dakota for two days (Steenhof 1976). Chainsaw activity 1.2 km (0.75 mi) from a Wisconsin roost may have driven eagles from the roost for the remainder of a winter season (Ingram personal communication).

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APPENDIX A. GUIDELINES FOR PLANTING COTTONWOODS (After McKnight 1970*)

1. Select a site with proper soil conditions and adequate moisture during the growing season. If possible, obtain a soil survey of your area to determine the best planting site. Ideally, the water table should be 1 to 2 m (3 to 6 ft) below the surface.

2. Plow or disk the site the summer before planting. Consider applying nitrogen fertilizer and pre-emergent herbicide if costs permit.

3. Secure 50 cm (20 inches) cuttings from 1 to 3 year old cottonwoods just before the growing season starts and just prior to planting. The source of stock should come from within 325 km (200 mi) of the planting site. Use only cuttings 1.3 to 2.5 cm (0.5 to 1.0 inches) in diameter. Discard crooked, split, or peeled sections of stems.

4. Wrap cuttings in wet burlap to keep them from drying. Soak the cuttings in water three days prior to planting until they are fully saturated.

5. Plant cuttings as early in the growing season as possible. Make 2.5 cm (1 inch) diameter planting holes with a rod, and space the holes on a 3.7 by 3.7 m (12 by 12 ft) grid. Insert the butt ends of the cuttings in the holes. Plant the cuttings 45 cm (18 inches) deep with 5 cm (2 inches) exposed.

6. Cultivate between the planted rows to control weeds during the first year of growth. It may be necessary to exclude deer, cattle, and beaver from the newly planted area during the first year.

7. Thin the stand by removing trees in alternate rows when tree diameters reach approximately 20 cm (8 inches). Subsequent thinnings should be made when the larger trees are 30 cm (12 inches) in diameter. Remove only the smaller trees in the second thinning.

* McKnight, J.S. 1970. Planting cottonwood cuttings for timber production in the South. S. Forest Exp. Sta., New Orleans, La. 17 pp. (USDA Forest Serv. Res. Pap. SO-60).

APPENDIX B. CONVEYANCE OF EASEMENT FOR PROTECTION AND AGREEMENT FOR MAINTENANCE OF BALD EAGLE WINTERING HABITAT

THIS INDENTURE, Made this ___day of _____, 19___, by and between _____ of _____, in the County of _____, State of _____, parties of the first part, and _____ of _____, in the County of _____, State of _____, party of the second part.

WITNESSETH:

WHEREAS, the land described below contains or includes habitat suitable for use by wintering Bald Eagles.

NOW, THEREFORE, for and in consideration of the sum of _____ ($) the parties of the first part, do hereby grant and convey an assignable easement and right in perpetuity unto the party of the second part, for the purpose of maintaining the land described below as habitat for bald eagles, together with the right of ingress and egress thereto, for the purpose of inspection and maintenance by the party of the second part, its agents and assigns, as follows:

Subject, however, to all existing rights-of-way for highways, roads, railroads, pipelines, canals, laterals, electrical transmission lines, telegraph and telephone lines, cable lines, and all outstanding mineral rights.

The parties of the first part, for themselves, and for their heirs, successors and assigns, covenant and agree that they will cooperate in the maintenance of the aforesaid lands as habitat for Bald Eagles; by not introducing practices which will interfere with or endanger Bald Eagles, without prior approval of the party of the second part, its agents and assigns; by not removing or permitting the removal of trees from the above-described lands by any means; by not constructing or placing thereon, or permitting the construction or placements thereon of year-round residential, recreational, or commercial structures including mobile homes, and by not granting easements for rights-of-way without prior approval of the party of the second part, its agents and assigns.

It is understood that this indenture imposes no other obligations or restrictions upon the parties of the first part and that neither they nor their successors, assigns, lessees, or any other person or party claiming under them shall in any way be restricted from carrying on farming practices such as grazing, hay cutting, plowing, working and cropping lands, and that they will utilize all of the subject lands in the customary manner except for the provisions mentioned above.

In witness whereof, the parties of the first part have hereunto set their hands and seals as of the day and year above written.

_____(Seal)_____(Seal)

_____(Seal)_____(Seal)

APPENDIX C. PERMIT FOR POWERLINE CONSTRUCTION ON PUBLIC LANDS

The applicant, grantee, or licensee shall be governed by "Suggested Practices for Raptor Protection on Powerlines." Use of this information should be made to design the proposed _____ (name or description of line) kV powerline for designated raptor areas with proper grounding, phase spacing and configuration such that it will prevent, to the best of the design engineer's ability, the electrocution of raptors. The applicant shall provide for the grantor, or licensor, drawings which show phase spacings, configurations and grounding practices of the proposed line, and these shall be made a part of the permit.

The use of designs other than those included herein that are, in the opinion of a raptor expert, raptor safe, shall be permitted on public land rights-of-way. The costs for review of such alternate designs shall be at the applicant's expense.

The grantor, or licensor, in issuing this permit, hereby assumes its responsibility to inform the applicant, grantee, or licensee of those areas which are designated habitats or potential habitats of raptors or other birds of prey. Any available biological or land management information in meeting the above-stated goal shall be made available to the engineer.

APPENDIX D.

BALD EAGLE PROTECTION ACT
16 U.S.C. 668-668c.

§ 668. Bald and golden eagles.

(a) Prohibited acts; criminal penalties.

Whoever, within the United States or any place subject to the jurisdiction thereof, without being permitted to do so as provided in sections 668 to 668d of this title, shall knowingly, or with wanton disregard for the consequences of his act take, possess, sell, purchase, barter, offer to sell, purchase or barter, transport, export or import, at any time or in any manner any bald eagle commonly known as the American eagle or any golden eagle, alive or dead, or any part, nest, or egg thereof of the foregoing eagles, or whoever violates any permit or regulation issued pursuant to sections 668 to 668d of this title, shall be fined not more than $5,000 or imprisoned not more than one year or both: *Provided*, That in the case of a second or subsequent conviction for a violation of this section committed after October 23, 1972, such person shall be fined not more than $10,000 or imprisoned not more than two years, or both: *Provided further*, That the commission of each taking or other act prohibited by this section with respect to a bald or golden eagle shall constitute a separate violation of this section: *Provided further*, That one-half of any such fine, but not to exceed $2,500, shall be paid to the person or persons giving information which leads to conviction: *Provided further*, That nothing in said sections shall be construed to prohibit possession or transportation of any bald eagle, alive or dead, or any part, nest, or egg thereof, lawfully taken prior to June 8, 1940, and that nothing in said sections shall be construed to prohibit possession or transportation of any golden eagle, alive or dead, or any part, nest, or egg thereof, lawfully taken prior to the addition to said setions of the provisions relating to preservation of the golden eagle.

(b) Civil penalties.

Whoever, within the United States or any place subject to the jurisdiction thereof, without being permitted to do so as provided in sections 668 to 668d of this title, shall take, possess, sell, purchase, barter, offer to sell, purchase or barter, transport, export or import, at any time or in any manner, any bald eagle, commonly known as the American eagle, or any golden eagle, alive or dead, or any part, nest, or egg thereof of the foregoing eagles, or whoever violates any permit or regulation issued pursuant to sections 668 to 668d of this title, may be assessed a civil penalty by the Secretary of not more than $5,000 for each such violation. Each violation shall be a separate offense. No penalty shall be assessed unless such person is given notice and opportunity for a hearing with respect to such violation. In determining the amount of the penalty, the gravity of the violation and the demonstrated good faith of the person charged shall be considered by the Secretary. For good cause shown, the Secretary may remit or mitigate any such penalty. Upon any failure to pay the penalty assessed under this section, the Secretary may request the Attorney General to institute a civil action in a district court of the United States for any district in which such person is found or resides or transacts business to collect the penalty and such court shall have jurisdiction to hear and decide any such action. In hearing any such action, the court must sustain the Secretary's action if supported by substantial evidence.

(c) Cancellation of grazing agreements.

The head of any Federal agency who has issued a lease, license, permit, or other agreement authorizing the grazing of domestic livestock on Federal lands to any person who is convicted of a violation of sections 668 to 668d of this title or of any permit or regulation issued hereunder may immediately cancel each such lease, license, permit, or other agreement. The United States shall not be liable for the payment of any compensation, reimbursement, or damages in connection with the cancellation of any lease, license, permit, or other agreement pursuant to this section. (As amended Oct. 23, 1972, Pub. L. 92-535, § 1, 86 Stat. 1064.)

§ 668a. Same; taking and using for scientific, exhibition and religious purposes.

Whenever, after investigation, the Secretary of the Interior shall determine that it is compatible with the preservation of the bald eagle or the golden eagle to permit the taking, possession, and transportation of specimens thereof for the scientific or exhibition purposes of public museums, scientific societies, and zoological parks, or for the religious purposes of Indian tribes, or that it is necessary to permit the taking of such eagles for the protection of wildlife or of agricultural or other interests in any particular locality, he may authorize the taking of such eagles pursuant to regulations which he is hereby authorized to prescribe: *Provided*, That on request of the Governor of any State, the Secretary of the Interior shall authorize the taking of golden eagles for the purpose of seasonally protecting domesticated flocks and herds in such State, in accordance with regulations established under the provisions of this section, in such part or parts of such State and for such periods as the Secretary determines to be necessary to protect such interest: *Provided further*, That bald eagles may not be taken for

any purpose unless, prior to such taking, a permit to do so is procured from the Secretary of the Interior: *Provided further*, That the Secretary of the Interior, pursuant to such regulations as he may prescribe, may permit the taking, possession, and transportation of golden eagles for the purposes of falconry, except that only golden eagles which would be taken because of depredations on livestock or wildlife may be taken for purposes of falconry. (As amended Oct. 23, 1972, Pub. L. 92-535, § 2, 86 Stat. 1065.)

§ 668b. Same; enforcement.

(a) Arrest; search; issuance and execution of warrants and process.

Any employee of the Department of the Interior authorized by the Secretary of the Interior to enforce the provisions of sections 668 to 668d of this title may, without warrant, arrest any person committing in his presence or view a violation of sections 668 to 668d of this title or of any permit or regulations issued hereunder and take such person immediately for examination or trial before an officer or court of competent jurisdiction; may execute any warrant or other process issued by an officer or court of competent jurisdiction for the enforcement of the provisions of sections 668 to 668d of this title; and may, with or without a warrant, as authorized by law, search any place. The Secretary of the Interior is authorized to enter into cooperative agreements with State fish and wildlife agencies or other appropriate State authorities to facilitate enforcement of sections 668 to 668d of this title, and by said agreements to delegate such enforcement authority to State law enforcement personnel as he deems appropriate for effective enforcement of sections 668 to 668d of this title. Any judge of any court established under the laws of the United States, and any United States commissioner may, within his respective jurisdiction, upon proper oath or affirmation showing probable cause, issue warrants in all such cases.

(b) Forfeiture.

All bald or golden eagles, or parts, nests, or eggs thereof, taken, possessed, sold, purchased, bartered, offered for sale, purchase, or barter, transported, exported, or imported contrary to the provisions of sections 668 to 668d of this title, or of any permit or regulation issued hereunder, and all guns, traps, nets, and other equipment, vessels, vehicles, aircraft, and other means of transportation used to aid in the taking, possessing, selling, purchasing, bartering, offering for sale, purchase, or barter, transporting, exporting, or importing of any bird, or part, nest, or egg thereof, in violation of sections 668 to 668d of this title or of any permit or regulation issued hereunder shall be subject to forfeiture to the United States.

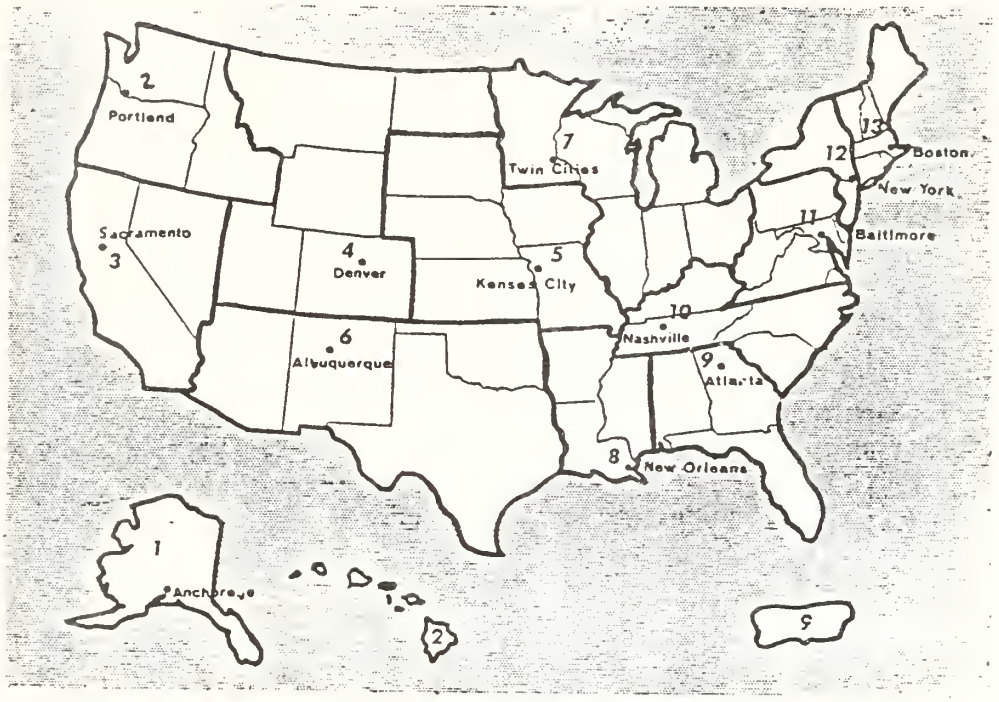
(c) Customs laws applied.

All provisions of law relating to the seizure, forfeiture, and condemnation of a vessel for violation of the customs laws, the disposition of such vessel or the proceeds from the sale thereof, and the remission or mitigation of such forfeitures, shall apply to the seizures and forfeitures incurred, or alleged to have been incurred, under the provisions of sections 668 to 668d of this title, insofar as such provisions of law are applicable and not inconsistent with the provisions of sections 668 to 668d of this title: *Provided*, That all powers, rights, and duties conferred or imposed by the customs laws upon any officer or employee of the Treasury Department shall, for the purposes of sections 668 to 668d of this title, be exercised or performed by the Secretary of the Interior or by such persons as he may designate. (As amended Oct. 23, 1972, Pub. L. 92-535, § 3, 86 Stat. 1065.)

§ 668c. Same; definitions.

As used in sections 668 to 668d of this title "whoever" includes also associations, partnerships, and corporations; "take" includes also pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb; "transport" includes also ship, convey, carry, or transport by any means whatever, and deliver or receive or cause to be delivered or received for such shipment, conveyance, carriage, or transportation. (As amended Oct. 23, 1972, Pub. L. 92-535, § 4, 86 Stat. 1065.)

APPENDIX E. LOCATION OF U.S. FISH AND WILDLIFE SPECIAL AGENT IN CHARGE OFFICES.



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U.S. Fish and Wildlife Service

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